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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER

OLSEN, ALLAN W

ART UNIT	PAPER NUMBER
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1763

DATE MAILED: 02/03/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/986,987

Applicant(s)

NISHIDA, TAKANOBU

Examiner

Allan Olsen

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 23 June 2004.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-4, 7-14 and 16-23 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-4, 7-14 and 16-23 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 13 November 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 2/26/04 . 6) ☐ Other: _____

DETAILED ACTION

The rejections of the July 15, 2004 Office action are maintained and are repeated below with minor changes in response to the amendment file November 15, 2004. See Response to Arguments below for additional comments.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1-4, 7-14 and 16- 23 are rejected under 35 U.S.C. 102(e) as being anticipated by U.S. Patent Application Publication 2003/0162407 of Maex et al. (hereinafter, Maex).

Maex teaches an etching method that includes the stripping or removal of a photoresist layer from an underlying insulating layer. The photoresist is removed by using a plasma generated from a mixture of O₂ and N₂. Maex teaches supplying RF energy from one power supply to excite the gas mixture into a plasma state while a separate power source supplies an RF bias potential to the substrate. Maex teaches using an RF plasma source power of 400 W and a RF bias power of 200 W while the substrate temperature is set at 20° C. Maex teaches that the method is designed to preserve the k-value of low-k dielectric materials. Maex teaches that the k-value is

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preserved by virtue of a protective coating that forms over. See: abstract; paragraphs [0018], [0063]-[0072] and [0085].

Claims 19 is rejected under 35 U.S.C. 102(e) as being anticipated by U.S. Patent 6,440,864 issued to Kropewnicki et al (hereinafter, Kropewnicki).

Kropewnicki teaches ashing a layer of photoresist with an oxygen plasma generated with between 100 and 5000 W of RF energy from a plasma source power supply while a second RF power supply provides between about 75 and 500 W of RF bias power to the pedestal electrode upon which the substrate is supported. These power limits provide for a source/bias power ratio of as low as 0.2. As Kropewnicki teaches etching the same material with the same gases and under the same conditions as the claimed invention, the formation of a protective film it is considered to be an inherent feature of Kropewnicki.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 1-4, 7-14 and 16-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over US Patent Kropewnicki in view of U.S Patent 5,453,157 issued to Jeng.

Kropewnicki teaches ashing a layer of photoresist with an oxygen plasma generated with between 100 and 5000 W of RF energy from a plasma source power supply while a second RF power supply provides between about 75 and 500 W of RF bias power to the temperature controlled pedestal electrode upon which the substrate is supported. These power limits provide for a source/bias power ratio of as low as 0.2. Kropewnicki teaches a temperature of about 15°C to about 20°C. See: col 2, ln 13-21; col 5, ln 22-25; col 6, ln 55-60; col 7, ln 27, 62-65; col 11 ln 22-25; and col 12 ln 50-52.

Kropewnicki does not explicitly teach that the low-k material is not damaged or that the value of the dielectric constant does not change by more than 10 %.

It would have been obvious to one skilled in the art to conduct the method of Kropewnicki in a manner that did not cause the dielectric constant of the low- k material to change by $\geq 10\%$ because Kropewnicki teaches the ashing of photoresist from atop a material having a dielectric constant of less than about 3.2 and more preferably less than about 3.0. As such, the dielectric constant of a material with the preferred dielectric constant of 3.0 cannot change by $\geq 10\%$ because this would result in a dielectric constant that exceeds Kropewnicki's upper limit of 3.2

As noted above, Kropewnicki teaches a temperature of about 15°C to about 20°C. While the examiner believes this temperature is recited in reference to the substrate temperature, Kropewnicki is not explicit on this point.

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Jeng teaches a method of ashing photoresist etching that overlies a low-k dielectric layer. Jeng teaches that damage to polymeric low-k dielectric materials, such as those of Kropewnicki, can be eliminated by maintaining the temperature of the substrate between -20° C and 20°C during the photoresist ashing process.

It would have been obvious to one skilled in the art to maintain a substrate temperature of 20°C or less while carrying out the method of Kropewnicki because Kropewnicki is directed to a process of ashing photoresist in the presence of low-k dielectric materials and Jeng teaches that damage to the dielectric material can be eliminated by maintaining a low substrate temperature. Even if the skilled artisan does not presume that Kropewnicki's teaching of a 15°C-20°C temperature is directed to the substrate temperature, the skilled artisan would, nevertheless, be motivated to use the low substrate temperature of Jeng because Jeng teaches that this eliminates damage to the low-k material, which in turn eliminates the prospect of bringing about deleterious changes in the value of the dielectric constant.

Regarding claim 15, Kropewnicki does not teach the formation of a protective film on the surface of the insulating film. However, like Applicant, Kropewnicki teaches using a silicon-containing organic polymer as the low k insulating film. Applicant's specification (page 10) attributes the formation of protection film to the migration of silicon to the surface to react with the reactive oxygen species generated from the plasma. Kropewnicki does not discuss this aspect of the claimed invention, nevertheless, the claimed protective film must also be present in Kropewnicki.

Response to Arguments

Applicant's arguments filed November 15, 2004 have been fully considered but they are not persuasive.

With respect to the Maex reference, applicant argues that Maex does not teach a process that constitutes the ashing of resist. Applicant asserts that the disclosure of Maex upon which the examiner has relied is concerned with the etching of the dielectric layer and as such the conditions do not address a resist ashing process. Applicant argues:

"From Fig. 8(e) and paragraph: [0078], it is understood that a second hard mask 16 is removed simultaneously with the formation of a contact hole 20. However, the hard mask layer of Maex is an inorganic layer such as a silicon oxide layer (see 12th line from the bottom of paragraph [0008] and lines thereafter), which cannot be reduced to ashes. Removal of a hard mask layer as taught by Maex does not teach or suggest ashing of a resist mask layer as claimed by Applicant."

The examiner believes these arguments to be based upon an incorrect analysis of Maex. Maex teaches in paragraph [0078] that the etching process is selective to the first and second hard mask layers. By this, Maex means that the hard masks are not removed. By backing up to paragraph 0075 one sees that a first hard mask layer 13 is patterned upon a first dielectric layer. A second dielectric layer, 15, is formed upon the first patterned hard mask. Upon the second dielectric layer a bilayered mask 16 is deposited and patterned. The bilayer mask comprises a lower hard mask layer with an

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overlying resist layer. Paragraph 0078 describes the steps that are taken in order to etch two different holes to two different depths as shown in figure 8(e). The first step etches into the second dielectric layer 15 but stops short of reaching the first hard mask layer 13. The second step uses a different etch chemistry that is selective to the first and second hard mask layers. It is critical that the hard mask layers not be removed in order to keep the shallow from extending down into the first dielectric layer. Maex does not teach simultaneously etching the dielectric layer and removal of a hard mask layer as applicant contends. The examiner notes that Maex repeatedly teaches the use of a bi-layered mask which consists of a first hardmask layer and a second overlying resist layer. Maex repeatedly teaches simultaneously removing resist (see, for example, [0015], [0017], [0057]) Throughout Maex it is clear that the term "resist" refers to an organic photoresist material (notes, at least, paragraphs 50 and 68) which is removed by ashing with an oxygen based plasma.

With respect to Kropewnicki, applicant argues, "Kropewnicki does not describe a structure that an insulating film such as a low constant dielectric film is provided between a resist film and a substrate."

The examiner disagrees and respectfully calls applicant's attention to figure 1A wherein an insulating film 45 is provided between a resist film 50 and a substrate 30/40.

Additionally, applicant argues that Kropewnicki does not teach a W_s/W_b ratio of 5 or less. However, as noted in the above rejections, Kropewnicki teaches ashing a layer of photoresist with an oxygen plasma generated with between 100 and 5000 W of RF

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energy from a plasma source power supply while a second RF power supply provides between about 75 and 500 W of RF bias power to the pedestal electrode upon which the substrate is supported. These power limits provide for a source/bias power ratio of as low as 0.2.

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

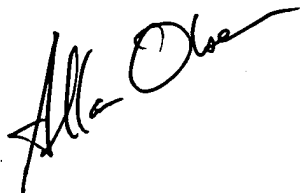
A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Allan Olsen whose telephone number is 571-272-1441. The examiner can normally be reached on M-F 1-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Greg Mills can be reached on 571-272-1439. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

A handwritten signature in black ink, appearing to read "Allan Olsen", written in a cursive style.

Allan Olsen
Primary Examiner
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